

## EFFECT OF PRUNING ON COCOA (*THEOBROMA CACAO* L) ON MORPHOLOGICAL, FLOWERING AND YIELD AND QUALITY OF COCOA BEANS

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### ABSTRACT

An experiment was conducted, to study the effect of canopy management in cocoa (*Theobroma cacao* L.), at Department of Spices and Plantation Crops, Horticultural College and Research Institute, Coimbatore during the year 2011 – 2012. The experiment was laid out in a randomized block design with five treatments with four replications each consisted of five trees. The pruning intensities were light pruning, medium pruning, heavy pruning, open centre pruning and control farmer's practice, i.e., sanitary pruning (removal of unnecessary chupons and dead branches). The studies were made on various parameters like morphological, physiological, yield and quality and biochemical parameters. In morphological character the number days taken for flowering from pruning, flower cushions per tree and number of flowers per cushion per tree and in a fruiting character number of pods per tree, pod weight (g), the number of beans per pod, wet bean weight per pod (g), dry bean weight per pod (g), dry yield per tree (Kg) were assessed. The treatments did exhibit significant differences, among the other treatment methods Medium Pruning (20% reduction of secondary branches) resulted in the improvement of all beneficial parameters leading to enhanced yield and quality of cocoa.

**KEYWORDS:** Cocoa, Canopy Management, Pruning, Flowering, Yield & Quality

**Received:** Sep 14, 2017; **Accepted:** Oct 02, 2017; **Published:** Oct 28, 2017; **Paper Id.:** IJASRDEC201714

### INTRODUCTION

Cocoa is an important plantation crop grown for chocolates around the world. In India Cocoa is being cultivated in the States of Kerala, Karnataka, Andhra Pradesh and Tamil Nadu in an area of 78000 ha with total production of 16,050 MT. Cocoa plants are grown under the shade of areca nut and coconut plantations in South India (Bhat, 1988). It is therefore, necessary to regulate the canopy size and shape of the cocoa plants. Yield of both cocoa and main crop are not to be affected under such circumstances, pruning becomes absolutely essential to strike a balance between growths and yield. Pruning, for maintenance and rehabilitation is performed during cocoa life cycle (Yusoff and Samad, 1996). It is a regular practice in all cocoa growing countries, except in West Africa. In India, formative pruning is practiced in the initial years of cocoa planting, followed by maintenance pruning as annual practice. The trees are restricted to the first jorquette and chupons are removed from the trunks (Swarbrick, 1965).

Cocoa plants derived from fan branches tend to produce low and brush wood like canopies, under such circumstances the best formative pruning method is to leave 3- 4 branches low down (Prawoto, 1996). All the chupons arising below the jorquette, have to be cut regularly to maintain the height. When the jorquette is formed at

lower heights, it should be removed at an early stage to facilitate upward growth. This is practiced mainly in Malaysia to achieve a jorquette height of 1.6 m (Leach *et al.*, 1971). Cocoa is hardly grown as a mono crop. Its imminent capacity to share the alley spaces of tall growing coconut and areca nut palms (Alvim and Nair, 1986) and its compatibility with the microclimatic conditions, available in such perennial gardens helps its cultivation in utilizing such areas, without exacting for an independent growing climate of its own. In the present investigation, under south Indian conditions, attempts were made to compare tree pruning intensities, along with open centre pruning and farmer's practice of pruning, *i.e.*, sanitary pruning (removal of unnecessary chupons, dead branches, epiphytes, climbing plants, diseased and over ripe pods), on yield and quality of cocoa trees (Balasimha, 2002).

## MATERIALS AND METHODS

This experiment was initiated in a farmer's field in Pollachi, during 2010, to analyze suitable pruning practice for Cocoa, as an intercrop in coconut garden. An experimental area was laid out in six year old orchards of *the Forastero type* of cocoa, in a randomized block design with five treatments in four replications. Treatments were imparted as per their pruning intensity; T<sub>1</sub> Light Pruning (10% reduction of secondary branches), T<sub>2</sub> Medium Pruning (20% reduction of secondary branches), T<sub>3</sub> Heavy Pruning (30% reduction of secondary branches), T<sub>4</sub> Open centre Pruning and T<sub>5</sub> Farmer's practice (Control). Each treatment unit consisted of five trees per replication. Morphological and physiological characters before and after pruning June and July respectively like the weight of pruning branches (kg) and fruiting characters like number of pods per tree, pod weight (g), fresh husk weight (g), the number of beans per pod, wet bean weight per pod (g), dry bean weight per pod (g), dry yield per tree were assessed (Kg). Biochemical characters like total phenol content (mg), soluble protein content (mg) and fat percentage also were recorded.

## RESULTS AND DISCUSSIONS

Pruning treatments did exhibit significant differences among the data were analyzed statistically as T<sub>2</sub> Medium Pruning (20% reduction of secondary branches) method suggested by Suresh, (2011) treatments on growth and development, physiology, yield quality and biochemical parameters. Pruning involves removal of biomass from the plants. Naturally, the plant will replenish the loss in terms of emergence of new shoots. In the present study, with an increase in intensity of pruning, the loss of biomass was more in fresh and dry weight of pruned branches. The highest freshers and dry weights of pruning branches were registered, by heavy pruning (30 percent), followed by open centre pruning method (Figure. 1). Similar results were also reported in cocoa by Suresh, (2011).

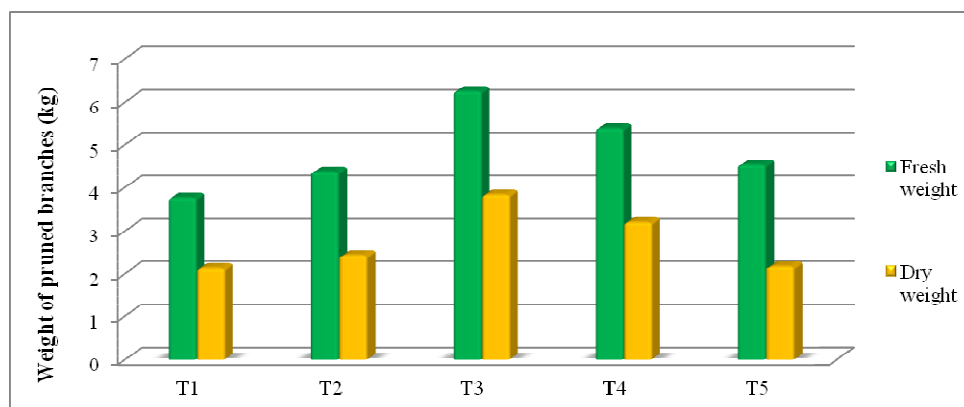


Figure 1: Effect of Pruning on Weight of Pruned Branches Removed in Cocoa

### Types of Pruning

T <sub>1</sub> -	Light Pruning (10 per cent)	T <sub>2</sub> -	Medium Pruning (20 per cent)
T <sub>3</sub> -	Heavy Pruning (30 per cent)	T <sub>4</sub> -	Open centre Pruning
T <sub>5</sub> -	Control (farmer's practice)		

Canopy spread of cocoa trees after pruning exhibited differences before and after pruning (Figure. 1) Light pruning recorded the highest canopy spread in both east-west and north-south direction (4.83 m and 4.79 m respectively). However, eight months after pruning, the trend was different, i.e. open centre pruning registered the widest canopy spread in respect of both east-west and north south directions (5.28 m and 5.26 m respectively). Pruning not only regulates the canopy size, but also ensures quality, size and appearance of fruits through better exposure of branches and fruits to sunlight. Any management practices, besides increasing the productivity, should also aim at the production of better quality fruits. This is true in the case of canopy management practices, wherein the main objective is to permit better aeration and light to fall on the inner parts of the trees, so that the developing fruits attain better colour and quality.

**Table 1: Effect of Pruning on Days Taken for Flowering after Pruning, Number of Flower Cushions per Tree and Number of Flowers Per Flower Cushion in Cocoa**

T. No.	Treatment	Days Taken for Flowering from Pruning (Days)	Flower Cushions Number per Tree	Flowers Number per Flower Cushion per Tree
T <sub>1</sub>	Light Pruning (10%)	37.24	355.7	5.0
T <sub>2</sub>	Medium Pruning (20%)	39.67	415.6	5.2
T <sub>3</sub>	Heavy Pruning (30%)	45.08	249.0	4.8
T <sub>4</sub>	Open centre Pruning	46.32	367.9	4.9
T <sub>5</sub>	Control (farmer's practice)	32.53	432.2	5.0
S.Ed		0.53	30.57	0.19
CD (P=0.05)		1.16	66.62	NS

Cocoa flowering is cauliflorous in nature, giving the impression that the flowers originate directly from the bark of the plant. The flowering peak varied with different locations depending on the rainy season (Young, 1984). Apart from rainfall, solar radiation is another major factor in influencing flowering. Consequently, removal of shade results in increase in flower production and pod yield (Hurd and Cunningham, 1961). In the present study, various pruning treatments exhibited considerable variation for the number of days taken for flowering after pruning which ranged from 32.53 to 46.32 days. The open centre pruning took a number of days for flowering and severe pruning resulted relatively in number of days from pruning of flowering.

**Table 2: Effect of Pruning on Yield of Pod Characters and Wet and Dry Bean Characters of Cocoa**

T. No.	Treatment	Pod Number Per Tree	Pod Weight (G)	Fresh Husk Weight (G)	Wet Bean Weight Per Pod (G)	Bean Number Per Pod	Dry Bean Weight Per Pod (G)
T <sub>1</sub>	Light Pruning (10%)	37.18	498	394	104	39.75	41.79
T <sub>2</sub>	Medium Pruning (20%)	39.24	526	424	102	42.37	44.91
T <sub>3</sub>	Heavy Pruning (30%)	35.24	478	373	105	34.75	40.99
T <sub>4</sub>	Open centre Pruning	30.61	467	368	99	36.75	38.59
T <sub>5</sub>	Control (farmer's practice)	35.66	496	392	104	41.20	42.04
S.Ed		0.55	5.32	4.03	1.19	1.28	1.28
CD (P=0.05)		1.20	11.60	8.78	2.60	2.80	2.80

Table 2 shows the decreasing trend with respect to number of pods harvested, with increasing in severity of

pruning as there was a reduction in the number of pods per tree. In general, medium pruning registered the highest number of yield attributes while affirming to this heavy pruning had very low number of pods per tree. Medium pruning recorded the highest number of pods per tree (39.24) and number of beans per pod (42.37) whereas heavy pruning recorded the lowest in bean number per pod and number of pods per tree. With regard to quantum yield characters viz, dry bean weight per pod (44.91 g), dry bean yield per tree (1.90 kg) and medium pruning registered the highest values. The lowest values of dry bean yield were recorded in heavy pruning and open centre pruning (1.14 kg per tree). The higher the dry bean yield per tree, it would result in higher yield in any plantation. The data clearly favor the medium pruning, to have more yield attributes like pod number per tree, dry bean weight per pod and dry bean yield per tree, when compared with other treatments.

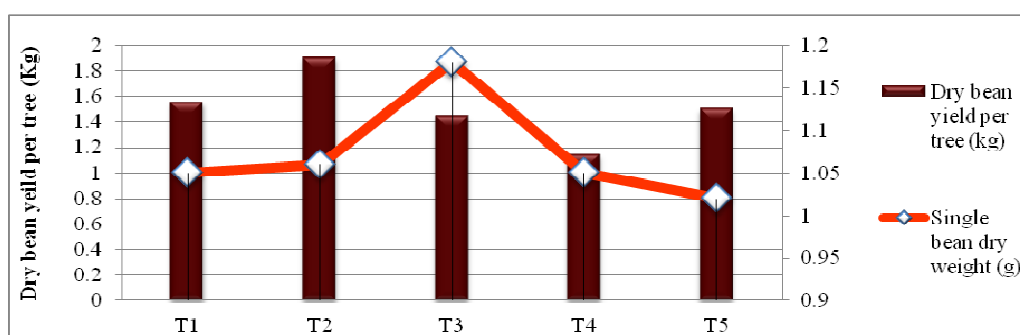


Figure 13: Effect of Pruning on Yield Traits (Dry Bean Yield per Tree Single Bean Dry Weight) in Coco

T<sub>1</sub> Light Pruning (10 per cent)

T<sub>2</sub> - Medium Pruning (20 per cent)

T<sub>3</sub> - Heavy Pruning (30 per cent)

T<sub>4</sub> - Open centre Pruning

T<sub>5</sub> - Control (farmer's practice)

The word quality in cocoa includes all the important factors of flavor and purity and mainly depends on bean size, shell percentage, fat content and the number of defective beans. The quality of cocoa beans in the present investigation showed that medium pruning treatment registered the highest soluble protein (15.63 mg per g), total phenols (2.31 mg/100g) and fat content (45.86 per cent) when compared to rest of the pruning treatments (Table 3). In the present study, medium pruning (removal of 20 per cent secondary branches) where light penetration was considered to be in optimum condition. Besides, lesser number of fruits in the severe pruning, (removal of 30 per cent secondary branches) led to less competition among the fruits, finally the fruit quality. The results confirmed the earlier reports in mango by Pratap *et al.* (2003) and Sanjaykumar (2010).

Table 3: Effect of Pruning on Soluble Protein (mg per g), Total Phenols (mg per g) and Fat (Percent) in Cocoa Bean

T. No	Treatment	Soluble Protein (mg per g)	Total Phenols (mg per 100g)	Fat (per cent)
T <sub>1</sub>	Light Pruning (10%)	14.72	2.19	39.42
T <sub>2</sub>	Medium Pruning (20%)	15.63	2.31	45.86
T <sub>3</sub>	Heavy Pruning (30%)	13.18	2.11	38.18
T <sub>4</sub>	Open centre Pruning	12.14	1.94	36.27
T <sub>5</sub>	Control (farmer's practice)	13.87	2.16	42.21
S.Ed		0.25	0.02	0.79
CD (P=0.05)		0.54	0.06	1.73

In cocoa, earlier studies showed that, for optimum production, proper canopy management has to be maintained with optimum shape and size (Balashimha, 2007). In a pruning experiment with three types of pruning viz., discretionary pruning, strict pruning and no pruning, the discretionary pruning showed higher yields as reported by Martin and Prasad (1983). The present study clearly favoured the medium pruning as the best treatment in the second year where the removal of 20 per cent of secondary branches gave the highest pod yield. The treatment had more potential flower production like flower cushion and flower number per cushion resulted in better yield record of 1.90 Kg of dry beans of cocoa per tree (Figure. 3). However, overlapping canopy is a great concern in this treatment to keep the tree well in shape and size within the manageable limit. Comparative analysis of economic characters of cocoa on pruning treatments showed that the pod number per tree, pod weight, bean number per tree, single bean, dry weight, and dry bean weight per pod and dry bean yield per tree were found to be higher in medium pruning (20 per cent) when compared with rest of the treatment.

## CONCLUSIONS

In a nutshell, taking into consideration of the performance of various treatments on different traits of the crop studied, particularly yield and yield components, it could be concluded that, the treatment, i.e. medium pruning (20 per cent) has resulted in the improvement of all beneficial parameters leading to enhanced yield and quality of cocoa. However, for a better understanding of various intensities of pruning in cocoa under coconut ecosystem, further more experimentation is essential and recommended.

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